

# CLAIMS

Restuct Cl 26,27, 28,29 two groups

1. A radiation curable adhesive composition comprising:

- a) an  $\alpha,\beta$ -olefinically unsaturated ether monomer component consisting of one or more compounds having the formula:



where R is an n-valent carbon-linked organic group R' is H or a monovalent carbon-linked organic group and n has a value of 1 or more, *upper limit 3*

- b) an elastomeric polymer having a tensile strength at break of greater than 1500 psi (10342 kPa), and an elongation at break of greater than 100%,

- c) a cationic photoinitiator.

2. An adhesive composition as in claim 1 wherein in monomer component

- a), formula (I), *n is 1 to 100.*

3. An adhesive composition as in claim 1 wherein in monomer component

- a), formula (I), *n is 1-6.*

4. An adhesive composition as in claim 1 wherein R and R' are selected from the group consisting of 1- 40 carbon aromatic or aliphatic hydrocarbon groups, polyethers, cycloethers, residues of hydroxyl terminated urethane oligomers, residues of hydroxyl terminated polyesters, and mixtures thereof.

5. An adhesive composition as in claim 1 wherein the monomer component

- a) is employed in the composition in an amount of from about 20% to about 98% by weight of the composition.

6. An adhesive composition as in claim 5 wherein the monomer component

- a) is selected from the group consisting of butyl vinyl ether, hydroxy butyl vinyl ether, cyclohexyl vinyl ether, phenoxy vinyl ether, 2-ethylhexyl vinyl ether, lauryl vinyl ether, cetyl vinyl ether, and octadecyl vinyl ether; divinyl ethers of hexanediol, cyclohexane dimethanol, triethylene glycol, bisphenol A, alkoxylated bisphenol A, and tetraethylene glycol; di- and tri- vinyl ethers of glycerol or trimethylolpropane; di-, tri- and tetra-vinyl ethers of pentaerythritol; 1,2-dipropenoxyethane, 1,4-dipropenoxybutane, 1,6-propenoxyhexane, 1,3-dipropenoxypropane, 1,4-cyclohexanedimethanol dipropenyl ether, 1,4-cyclohexane dipropenyl ether, 1,2-dipropenoxypropane, 1,10-dipropenoxydecane, 1,8-dipropenoxyoctane, 1,2,3-tripropenoxypropane, 1,2,3,4-

tetrapropenoxybutane, sorbitol hexapropenyl ether, trimethylolpropane tripropenyl ether, pentaerythritol tetrapropenyl ether, 1,2-dipropenoxycyclopentane, 1,3-dipropenoxyperfluoropropane, diethyleneglycol dipropenyl ether, tetraethyleneglycol dipropenyl ether, and 3,4-dipropenoxytetrahydrofuran; and mixtures thereof.

- 5 7. An adhesive composition as in claim 1 wherein the elastomeric polymer component b) is selected from the group consisting of acrylic rubbers, butadiene/acrylonitrile rubber, styrene/butadiene rubber, buna rubber, polyisobutylene, polyisoprene, natural rubber, polyurethane rubbers, ethylene-vinyl acetate polymers, fluorinated rubbers, isoprene-acrylonitrile polymers, chlorosulfonated polyethylenes,
- 10 homopolymers of polyvinyl acetate, and mixtures thereof.
8. An adhesive composition as in claim 7 wherein the elastomeric polymer component b) is an acrylic rubber selected from the group consisting of (i) homopolymers of alkyl esters of acrylic acid, (ii) copolymers of another polymerizable monomer with an alkyl ester of acrylic acid or with an alkoxy ester of acrylic acid, (iv)
- 15 *15* copolymers of alkyl esters of acrylic acid, (v) copolymers of alkoxy esters of acrylic acid, and (vi) mixtures of any of the above (i)-(v). *no iii*
9. An adhesive composition as in claim 1 wherein the elastomeric polymer component b) has an average molecular weight of greater than 5,000.
10. An adhesive composition as in claim 9 wherein the elastomeric polymer
- 20 component b) has an average molecular weight of more than about 100,000, a Mooney viscosity of between 20 and about 60, and a glass transition temperature of 15° C or less.
11. An adhesive composition as in claim 1 wherein the elastomeric polymer component b) is an A-B-A block copolymer wherein the A block is polymerized segment of styrene, alpha-methyl styrene, t-butyl styrene, or other ring alkylated styrene,
- 25 acrylonitrile, methyl methacrylate, or a mixture of some or all of the above and the B block is an elastomeric segment derived from a conjugated diene or copolymer thereof or an ethylene-propylene monomer.
12. An adhesive composition as in claim 1 wherein the elastomeric polymer component b) is a millable polyurethane.
- 30 13. An adhesive composition as in claim 1 wherein the elastomeric polymer component b) is present in the composition in an amount of 3 to about 50 percent by

weight.

14. An adhesive composition as in claim 1 wherein the cationic photoinitiator component c) comprises an onium salt represented by the general formula:



where  $R^2$  is an aromatic radical or a mixture thereof,  $A^+$  is selected from the group of iodonium cation mono-substituted with  $C_1$  to  $C_{20}$  alkyl or aryl optionally substituted with  $C_1$  to  $C_{20}$  alkyl or alkoxy and sulfonium cation di-substituted with  $C_1$  to  $C_{20}$  alkyl or aryl optionally substituted with  $C_1$  to  $C_{20}$  alkyl or alkoxy or a mixture thereof and  $X^-$  is a non-basic, non-nucleophilic anion, or

an  $\eta^5, \eta^6$ -iron arene salt complex catalyst.

15. An adhesive composition as in claim 14 wherein  $R^2$  is aryl, alkaryl, or aralkyl, any of which may be optionally substituted with a linear, branched or cyclic  $C_8$  to  $C_{20}$  radical of alkyl, alkylene, alkoxy alkyleneoxy, a nitrogen, oxygen or sulfur heterocyclic radical of 4 to 6 carbon atoms in the ring and  $X^-$  is  $SbF_6^-$ ,  $AsF_6^-$ ,  $PF_6^-$ ,  $BF_4^-$ ,  $ClO_4^-$ , or  $CF_3SO_3^-$ .

16. An adhesive composition as in claim 1 wherein the cationic photoinitiator component c) is selected from the group consisting of diaryliodonium, triarylsulfonium, diaryliodosonium, triarylsulfoxonium, dialkylphenacylsulfonium, and alkylhydroxyphenylsulfonium salts and mixtures thereof.

17. An adhesive composition as in claim 1 wherein the cationic photoinitiator component c) is present in the composition in an amount of from about 0.01% to about 20% by weight.

25 18. An adhesive composition as in claim 1 further comprising one or more members of the group consisting of non-elastomeric polymers, inorganic fillers, storage stabilizers, viscosity modifiers, surface wetting property modifiers and adhesion promoters.

19. An adhesive composition as in claim 1 wherein the elastomeric polymer component b) has a tensile strength at break of greater than 2000 psi (13790 kPa) and an elongation at break of greater than 200%.

20. An adhesive composition as in claim 19 wherein said elastomeric polymeric component is a block copolymer which includes at least one block segment having a Tg of -20°C or less.
21. An adhesive composition as in claim 1 wherein R' is H or C<sub>1-10</sub> alkyl.
- 5 22. An adhesive composition as in claim 1 wherein R' is H or methyl.
23. A method of bonding comprising
- A) applying a composition as in claim 1 to a substrate,
- B) joining a second substrate, at least one of the substrates being transmissive to energy effective to activate the photoinitiator, and
- 10 C) transmitting energy effective to activate the photoinitiator through said transmissive substrate to the composition to effect cure of the composition.
24. A method as in claim 23 wherein said energy effective to activate the photoinitiator is heat, e-beam or electromagnetic energy in the IR, visible, UV or x-ray spectrum.
- 15 25. A method as in claim 24 wherein said energy effective to activate the photoinitiator is electromagnetic energy in the IR, visible or UV spectrum.
26. A bonded assembly produced by the method of claim 23.
27. An assembly comprising a pair of substrates bonded by a cured adhesive formulation wherein the adhesive formulation is a composition as in claim 1.
- 20 28. A polymeric reaction product obtained by curing a composition comprising
- a) an  $\alpha,\beta$ -olefinically unsaturated ether monomer component consisting of one or more compounds having the formula:
- $$R[O-CH=CHR^1]_n \quad (I)$$
- 25 where R is an n-valent carbon-linked organic group R<sup>1</sup> is H or a monovalent carbon-linked organic group and n has a value of 1 or more,
- b) an elastomeric polymer having a tensile strength at break of greater than 1500 psi (10342 kPa), and an elongation at break of greater than 100%,
- c) a cationic photoinitiator.
- 30 29. A polymeric reaction product as in claim 28 wherein R' is H or C<sub>1-10</sub> alkyl.